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The highest-intensity surface muon beam muE4 at PSI

abstract: At PSI the new surface muon beam muE4 with highest mu+ intensity - replacing the old muE4 decay muon channel - has come into operation at the end of 2005. The beam line with a design momentum of 28 MeV/c has been planned to serve the needs of the low-energy, polarized mu+ (LE-mu+) apparatus at PSI. A very large acceptance of about 200 msr is obtained by installing two solenoidal magnetic lenses close to the muon production target E that is hit by the 590 MeV PSI proton beam. These normal conducting solenoids limit the maximum beam momentum to 36 MeV/c. The beam is then transported by standard large aperture beam line elements to the experiment. Several slit systems and an electrostatic separator allow the control of the beam shape, momentum spread, and to reduce the background due to positrons or electrons.

At 28 MeV/c a maximum mu+ beam intensity of 210 M/mAs with a beam momentum width of 9% FWHM has been measured with a 4.2-cm long production target E. About 40% (85 M/mAs) hit the muon moderator with a size of 3x3 cm² to generate the currently most intensive LE-mu+ beam with tunable energies between 1 and 30 keV, which is used for unique thin-film solid state applications. With the alternatively useable 6-cm long target E the muon rate increases proportionally with target length.

This beam line demonstrates, how existing muon beams at present proton accelerators can be modified to achieve an order of magnitude larger phase space acceptance, which allows the generation of highest-intensity surface muon beams.